REMARKS/ARGUMENTS

This case has been reviewed and analyzed in view of the Official Action dated 17 June 2004. Responsive to the rejections made by the Examiner in the outstanding Official Action, Claims 1, 4, and 5 have been amended in order to more clearly clarify the inventive concept of the Applicant. Additionally, Claims 11-15, previously withdrawn by election of Claims due to a Restriction Requirement, have now been canceled from this case.

The Examiner has objected to Claim 5 due to an instance of lack of proper antecedent basis. Claim 5 has now been amended to overcome the Examiner's objection.

Prior to a discussion of the Examiner's further objections and rejections made in the outstanding Official Action, it is believed that it may be beneficial to briefly review the subject Patent Application system in light of the inventive concept of the Applicant.

The subject Patent Application system is directed to an anode stream recirculation system. As shown in Fig. 5 of the subject Patent Application Drawings, a fuel cell 80 includes an anode gas input 82 and an anode gas output 84. A switch 62 and a pressure regulating device 64 are provided between the anode gas supply 60 and the anode gas input 82. A diaphragm pump 70 is positioned so as to recirculate the gas output produced by anode gas output 84 back to the anode gas input 82. As better shown in Fig. 6, the diaphragm pump 70 includes a diaphragm 92 mounted on piston 90 with a magnet 110 mounted on the diaphragm 92. A pair of Hall effect sensors 106, 108 are provided, with

the first sensor 106 being mounted above the diaphragm and the second sensor 108 being mounted below the diaphragm. The Hall effect sensors 106, 108 detect the positioning of the diaphragm within the diaphragm pump 70 based upon the influence of magnet 110, with the sensors controlling the switch 62.

The Examiner has rejected Claims 1-2 and 4-8 under 35 U.S.C. § 103(a) as being unpatentable over the Fletcher Patent #5,798,186 in view of the Henkel Patent #4,966,528. It is the Examiner's contention that the Fletcher reference taken in combination with the Henkel reference teaches and suggests the use of a fuel cell power generation system combined with a diaphragm pump controlled by Hall effect sensors.

The Fletcher reference is directed to a method and apparatus for commencing operation of a fuel cell electric power generation system below the freezing temperature of water. The system includes a hydrogen supply 220 controlled by a pressure regulator 221. Hydrogen is recirculated through the system by a pump 224 along recirculation loop 225. The system, however, does not include a diaphragm pump.

The Henkel reference is directed to an apparatus for controlling the hydraulic circuit of a piston diaphragm pump. In the embodiment of Fig. 1, magnet 5 is connected to the inner side of the diaphragm 4 through a bolt 8 surrounded by a spring 7. During the diaphragm displacement, the magnet 5 is moved along axis B so that the distance X between magnet 5 and Hall generator 3 is permanently changing. Under use of the Hall

effect, a permanent differential measuring of the distance X is carried out, and the generated voltage signal is transmitted outwardly through a signal cable 10 within tube 7.

In the embodiment of Fig. 2, a pair of Hall effect sensors 35a, 35b are utilized, however, each displacement sensor 35a, 35b is associated with a single diaphragm pump, with Fig. 2 being directed to a two-fold effective piston diaphragm pump.

The Henkel reference does not teach or suggest the use of a pair of Hall effect sensors, with one being mounted above a diaphragm and the second being mounted below the same diaphragm.

The system of the subject Patent Application, shown specifically in Fig. 6 of the subject Patent Application Drawings, utilizes a first Hall effect sensor 106 mounted above the diaphragm 92 and a second Hall effect sensor 108 mounted below the diaphragm 92. This pair of Hall effect sensors is necessary for producing the most accurate measurements in order to control switch 62, which ultimately controls the flow of the anode gas into the fuel cell. The Hall effect is, essentially, the development of a transverse electric field in a current-carrying conductor placed in a magnetic field. Ordinarily, the conductor is positioned so that the magnetic field is perpendicular to the direction of current flow and the electric flow is perpendicular to both. Fuel cell systems, like most other power generation systems, are envisioned to ultimately be portable systems, for use in vehicles and other devices utilizing a personal power supply. Thus, both the physical dimensions of the fuel cell system and also the amounts of power

required to run the fuel cell system are minimized. In a system such as that shown in Figs. 5 and 6 of the subject Patent Application Drawings, the Hall effect sensors 106, 108, the magnet 110, and the structure of the diaphragm pump 70 are made as small as possible with the minimum amount of materials. Additionally, power flow for the Hall effect sensors 106, 108 is also minimized.

In order to get optimal position readings, a pair of Hall effect sensors is utilized, with Hall effect sensor 106 measuring the position of the piston/diaphragm when it is in its upper position and Hall effect sensor 108 measuring the position of the diaphragm/piston when it is in its lower position. At the preferred scale of a fuel cell system, the Hall effect sensors 106, 108 are highly sensitive, but do not have a great range of accurate measurement. Thus, the pair is necessary for the most accurate measurement of the position of the diaphragm 92.

Thus, neither the Fletcher reference nor the Henkel reference, when taken alone or in combination, provide for: "...wherein the diaphragm pump has first and second sensors...said first sensor being positioned above a diaphragm of said diaphragm pump, said second sensor being positioned below said diaphragm of said diaphragm pump, said first and second sensors detecting a position of said diaphragm...", as is clearly provided by newly-amended Independent Claim 1. Further, neither the Fletcher reference nor the Henkel reference, when taken alone or in combination, provide for: "...wherein the diaphragm pump comprises two Hall effect sensors with one disposed at an upper side

and the other disposed at a lower side of the diaphragm pump, and a magnetic member disposed on a piston to interact with the Hall effect sensors, each said Hall effect sensor measuring a position of a diaphragm assembly of said diaphragm pump...", as is clearly provided by newly-amended Independent Claim 5.

Thus, based upon newly-amended Independent Claims 1 and 5, it is not believed that the subject Patent Application is made obvious by either the Fletcher reference or the Henkel reference, when taken alone or in combination, when Independent Claims 1 and 5 are carefully reviewed.

The Examiner has further rejected Claim 3 under 35 U.S.C. § 103(a) as being unpatentable over the Fletcher reference in view of the Henkel reference as applied to Claim 1 above, and further in view of the Tanaka Patent #6,536,551. It is the Examiner's contention that it would have been obvious to one skilled in the art at the time the invention was made to use the electromagnetic valve of Tanaka in the anode stream recirculation system of Fletcher and Henkel.

The Tanaka reference is directed to a hydrogen using system for installation in vehicles and a control method for the system. The Tanaka reference has been cited by the Examiner because it teaches an electromagnetic valve, however, the system does not include a recirculation system for the anode gas, having a diaphragm pump, specifically including two Hall effect sensors, with the sensors sandwiching the inner diaphragm of the diaphragm pump.

As argued above with reference to the combination of the Fletcher reference and the Henkel reference, as applied to Claim 1, the subject Patent Application system utilizes a pair of Hall effect sensors 106, 108, shown in Fig. 6 of the subject Patent Application Drawings, in order to detect the position of magnet 110 which is fixed to the diaphragm 92 and piston 90. Due to the limitations in range of the Hall effect sensors, at the preferred scale and power consumption, the optimal sensing capabilities are achieved with the pair of Hall effect sensors, with one being mounted above the diaphragm, and one being mounted below the diaphragm, in order to control switch 62, shown in Fig. 5.

None of the Fletcher, Henkel, or Tanaka references, when taken alone or in combination, teach or suggest the use of two Hall effect sensors, with one being positioned above the diaphragm and one being positioned below the diaphragm, which is necessary for optimal and efficient sensing of the position of the diaphragm.

Thus, neither the Henkel reference, the Fletcher reference, nor the Tanaka reference, when taken alone or in combination, provide for: "...wherein the diaphragm pump has first and second sensors...said first sensor being positioned above a diaphragm of said diaphragm pump, said second sensor being positioned below said diaphragm of said diaphragm pump, said first and second sensors detecting a position of said diaphragm...", as is clearly provided by newly-amended Independent Claim 1. Further, neither the Fletcher reference, the Henkel reference, nor the Tanaka reference, when taken alone or in combination, provide for: "...wherein the diaphragm pump comprises

two Hall effect sensors with one disposed at an upper side and the other disposed at a lower side of the diaphragm pump, and a magnetic member disposed on a piston to interact with the Hall effect sensors, each said Hall effect sensor measuring a position of a diaphragm assembly of said diaphragm pump...", as is clearly provided by newly-amended Independent Claim 5.

Thus, based upon newly-amended Independent Claims 1 and 5, it is not believed that the subject Patent Application is made obvious by either the Tanaka reference, the Fletcher reference, or the Henkel reference, when taken alone or in combination, when Independent Claims 1 and 5 are carefully reviewed.

The Examiner has additionally rejected Claims 9-10 under 35 U.S.C. § 103(a) as being unpatentable over Fletcher in view of Henkel as applied to Claims 1 and 4 above, and further in view of Edlund. It is the Examiner's contention that it would have been obvious to one skilled in the art at the time the invention was made to use the specific check valves of Edlund in the anode stream recirculation system of Fletcher and Henkel.

The Edlund Patent Application Publication #2002/0119353 is directed to an integrated fuel cell system. The fuel cell system of Edlund includes a fuel cell, a fuel processor for producing hydrogen, and a dual-head pump 350 including a diaphragm pump or a piston pump. Though the Edlund reference utilizes valves 62 and 42 along with a pressure regulator 40, the Edlund reference does <u>not</u> include a recirculation system including the diaphragm pump having a pair of Hall effect sensors.

The Examiner has cited the Edlund reference purely for the use of the specific check valves to be combined with the systems of Henkel and Fletcher, however, as described above in reference to the rejection of Claims 1 and 4 by the Examiner's combination of the Henkel and Fletcher references, none of the Edlund reference, Fletcher reference, nor Henkel reference teach or suggest the use of a pair of Hall effect sensors, with a first Hall effect sensor being mounted above the diaphragm/piston of the diaphragm pump and the second Hall effect sensor being mounted below the diaphragm/piston.

As described above, the combination of an upper Hall effect sensor 106 with a lower Hall effect sensor 108, shown in Fig. 6 of the subject Patent Application Drawings is necessary for the optimal and most efficient sensing of the position of magnet 110, particularly taking the scale of the diaphragm pump into account, along with the minimal power input which is desired.

Thus, neither the Fletcher reference, the Henkel reference, nor the Edlund reference provide for: "...wherein the diaphragm pump has first and second sensors...said first sensor being positioned above a diaphragm of said diaphragm pump, said second sensor being positioned below said diaphragm of said diaphragm pump, said first and second sensors detecting a position of said diaphragm...", as is clearly provided by newly-amended Independent Claim 1. Further, neither the Fletcher reference, the Henkel reference, nor the Edlund reference, when taken alone or in combination, provide

for: "...wherein the diaphragm pump comprises two Hall effect sensors with one disposed at an upper side and the other disposed at a lower side of the diaphragm pump, and a magnetic member disposed on a piston to interact with the Hall effect sensors, each said Hall effect sensor measuring a position of a diaphragm assembly of said diaphragm pump...", as is clearly provided by newly-amended Independent Claim 5.

Thus, based upon newly-amended Independent Claims 1 and 5, it is not believed that the subject Patent Application is made obvious by either the Henkel reference, the Fletcher reference, or the Edlund reference, when taken alone or in combination, when Independent Claims 1 and 5 are carefully reviewed.

It is now believed that the remaining Claims 2-4, 6-10 show patentable distinction over the prior art cited by the Examiner for at least the same reasons as those previously discussed for Independent Claims 1 and 5.

It is now believed that the subject Patent Application has been placed in condition for allowance, and such action is respectfully requested.

Respectfully submitted,

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Dated: 9/3/04

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